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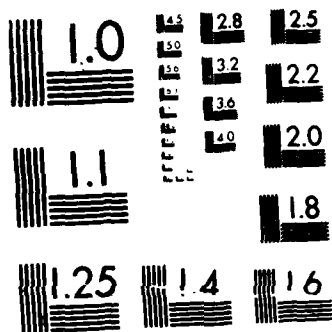
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Recent research results

(References preceded by R or S refer to bibliographic references of Rosenberg or Spruch, respectively)

Relativistic scattering in an external quasistatic electric field. (R85)

We studied the problem of the relativistic scattering of a charged particle in an external electric field. By imposing certain restrictions on the nature of the field we were able to derive an approximation for the transition amplitude of a particularly simple form, involving as input the physical scattering amplitude in the absence of the field. The basic assumption is that the field is a slowly varying function of time, falling to zero in the remote past and distant future. An additional assumption, which in practice represents a mild restriction on the applicability of the method, is that the energy of the particle is not appreciably affected by the field during the collision. The derivation was similar to earlier treatments of scattering in a low-frequency laser field.

Gauge-invariant approximations for scattering in a strong external field. (R87)

While the exact amplitude for scattering in the presence of an external electromagnetic field is gauge invariant the invariance property will not necessarily be preserved in approximations. This observation was the starting point for a reformulation of the scattering problem. In the new version the gauge-dependent vector and scalar potentials are replaced by gauge-independent effective potentials and this allows for the introduction of gauge-invariant approximations in a systematic way.

Extremum principle for relativistic bound-state energies (R88 or S 142)

Due to the existence of negative-energy solutions of the Dirac equation the usual form of the Rayleigh-Ritz minimum principle for the ground-state energy fails to hold for a Dirac particle in a potential. Nevertheless, the calculational problem can be formulated in terms of extremum principles, as we have shown.

Modified perturbation theory for scattering in a laser field (R89)

A variational formulation of the problem of nonrelativistic scattering in a laser field (R72) provides approximations to the transition amplitude correct to first order in the error in the trial function. We showed recently how to estimate the second-order error under the assumption that the interaction of the charged projectile with the laser field in virtual intermediate states is sufficiently weak to justify the use of perturbation theory. The effectively strong projectile-field interaction in initial and final states is treated nonperturbatively through suitable choice of trial functions.

Three papers (R81 or S138; R 83 or S 139; and R86 or S 140) were published on applications of Sturm-Liouville (SL) theory to a new derivation of Levinson's theorem, to a derivation of that theorem in a new domain- when repulsive Coulomb potentials are present-and to a study of the nodal structure of some simple many-body problems. The idea is to avoid the usual approach, based on analyticity, for the extension on that basis from potential scattering to many body scattering would be very difficult. On the other hand, there is an abundance of literature on SL theory as applied to potential and many-body problems.

A paper on the semiclassical evaluation of sums of squares of hydrogenic bound state functions: The sums are of interest in their own right and serve as a check on some extensions of Thomas-Fermi theory by Schwinger and co-workers. (See item S137.)

A paper on the interaction of an electromagnetic wave and an electron image bound to a conducting wall was published. (See item S 136.)



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